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McLEOD & HENRY CO.

Flat Suspended Furnace Arches
Complete Boiler Settings
Sprung Furnace Arches
Boiler-door Arches
Boiler Baffle Tile
Fire-box Lining

Established 1825
Originators of "Steel Mixture"

MAIN OFFICE AND WORKS: TROY, N. Y.
BRANCHES: NEW YORK, BOSTON AND DETROIT

Back-Combustion-Chamber Arches
Blow-off Pipe Protectors
High-temperature Cement
Special Fire Blocks
Standard Fire Brick
Fire Clay

STEEL MIXTURE
REG. U.S. PAT. OFF.

Bulletin 155

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May, 1923

The McLeod & Henry
Flat Suspended Furnace Arch

(Patents Pending)

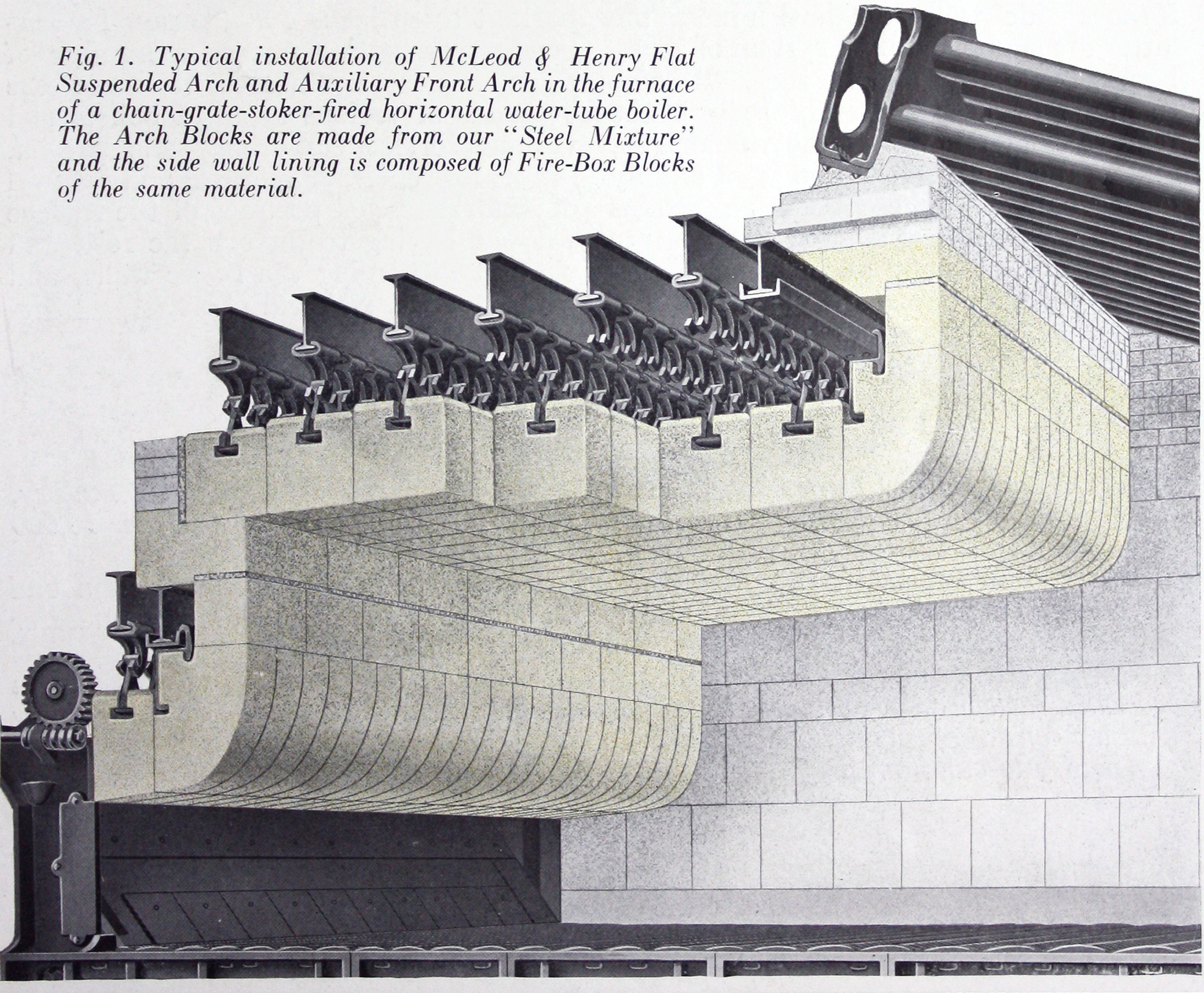

Fig. 1. Typical installation of McLeod & Henry Flat Suspended Arch and Auxiliary Front Arch in the furnace of a chain-grate-stoker-fired horizontal water-tube boiler. The Arch Blocks are made from our "Steel Mixture" and the side wall lining is composed of Fire-Box Blocks of the same material.

SPECIALISTS IN BOILER AND FURNACE REFRACTORIES FOR ALMOST 100 YEARS

FURNACE arches in steam power boilers form a complete or partial top for the combustion chamber and are intended to conduct or deflect the combustion gases into the most desirable path to the tube bank or flues. Their use and proper design are essential to thorough combustion, smoke reduction, and quick ignition of fuel, particularly at the feeding end of the furnace.

The earlier and commonest forms of furnace arch are sprung between the side walls, forming a convex surface over the fire. From a heat efficiency standpoint, this is objectionable in that the gases are diverted toward the center of the arch and therefore not equally distributed to the boiler heating surface. A construction fault exists also in that the thrust pressure from the arch tends to push the furnace side walls outward unless the latter are supported by a system of skewbacks, buck-stays and tie rods. Repairs to walls or arch generally require the removal and renewal of the whole arch, and as the bricks check and spall unduly on account of inherent design strains within the arch, and sudden temperature change from opening and closing of furnace doors, renewals are more frequent than they should be. The condition is further aggravated by attempts of inexperienced men to do the brickwork, which means that high expense for skilled labor must also be charged against the sprung-arch construction.

As a means of equalizing heat distribution, avoiding side pressure on the furnace walls, and prolonging life of all parts, large flat tile forming a perfectly flat furnace top, suspended from overhead cross-beams set in the furnace walls, were the next development. Owing to difficulties in placing and removal of large tile, and the impossibility of burning them to uniform finish and durability throughout, the maintenance cost was still excessive. The correctness of the flat surface was proven beyond any doubt, but it remained to provide two very important essentials:—*First*, means for suspending or setting one or a number of these flat arch surfaces to meet the demands of various types of boilers and various service conditions, and *Second*, means for repair, or removal and renewal of small damaged portions of the surface without having to disturb the rest, and without disturbing the boiler walls, and without great physical effort.

McLeod & Henry Furnace Refractories have been marketed for almost a century, and as now made from our "Steel Mixture," are doing good work in over 10,000 steam plants.

Their success comes largely from constant development to keep furnace design and performance abreast of other progress in steam generation, and our well known endeavor to give the customer good service rather than merely sell him material.

Our experience and achievements fit us well to handle any furnace problem, and in order that customers may get every benefit to which they are entitled, we co-operate willingly with the consulting engineer, owner, plant manager and operating engineer.

Inquiry to our nearest office will receive prompt attention.

McLEOD & HENRY CO.

The McLeod & Henry Flat Suspended Arch

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THE McLeod & Henry Arch meets these requirements wherever a complete or partial top surface is essential in a hot furnace. It divides the arch proper into small independent and independently suspended sections each of which has a fire-surface area of only 0.37 sq. ft. (12 in. by 4½ in.) and each of which can be removed and replaced or renewed independently of all others.

The blocks or units in the flat part of the arch are all uniform, interchangeable and of one standard size (Fig. 4, page 5), an arch of larger surface being obtained by using a correspondingly larger number of blocks. The completed surface is as symmetrical as that of a sheet of postage stamps. No grouting is necessary between the blocks, as they are very accurately made, they fit together closely and any slight voids at the joints are soon filled and kept sealed by the products of combustion.

The possibility of removal of any single block *without disturbing the rest*, and of repairing the arch completely or in part *from underneath* and without in any way disturbing the superimposed suspension beams and brickwork setting, are exclusive features with the McLeod & Henry Arch. The whole construction reduces maintenance expense and delays to almost nothing.

Suspension

EACH unit in the flat portion of the arch is suspended from its own hanger and rocking link, the latter engaging in an inverted T-slot in the top of the block, as shown in Fig. 3.

Each row of blocks is suspended from the lower flanges of a steel I-beam, by clips at the top of the hanger, which engage the tops of the beam flanges. The clips fit loosely upon the hanger beam and are easily slid over one end and spaced to conform with the size of the blocks.

These sets, consisting of hanger bar, suspension members and blocks, are installed in parallel, in number depending upon the width of the fire box, to provide a complete arch surface across the furnace.

The hanger beams rest on iron bearing plates embedded in and distributing the weight downward only on the side walls of the boiler. No skew-back irons, tie rods or stays are required as no side thrust is imposed on the boiler walls.

This is entirely practical as no open end is required to slide the blocks out, as where a whole row rests on a single fitting. The arrangement protects the metal parts from the direct heat of the fire and places them where ventilation prevents burning out or distortion, and where visible for inspection.

It is obvious that with the rigid well aligned support for the suspension, the bottoms of all blocks fall into the same plane and produce a perfectly flat surface. It is also to be noted that the whole suspension is very flexible and that each block is suspended straight downward. In the case of arches set on a slope, flat bottom surface with straight downward suspension is maintained by beveling the bottoms of the blocks to correspond with the slope, and by proper adjustment of the up-and-down position of the block. The latter is accomplished by the use of different thicknesses of bearing plates as shown in Fig. 1. Each block is free to move laterally in any direction, and with all blocks assembled, the mass can move as a whole to compensate perfectly for any expansion. To further guard against strain from expansion, the front and side edges of the arch are not in direct contact with the boiler walls but separated by a narrow space which is loosely packed with asbestos. This gas-tight cushion permits the arch and boiler walls to expand and contract entirely independent of each other.

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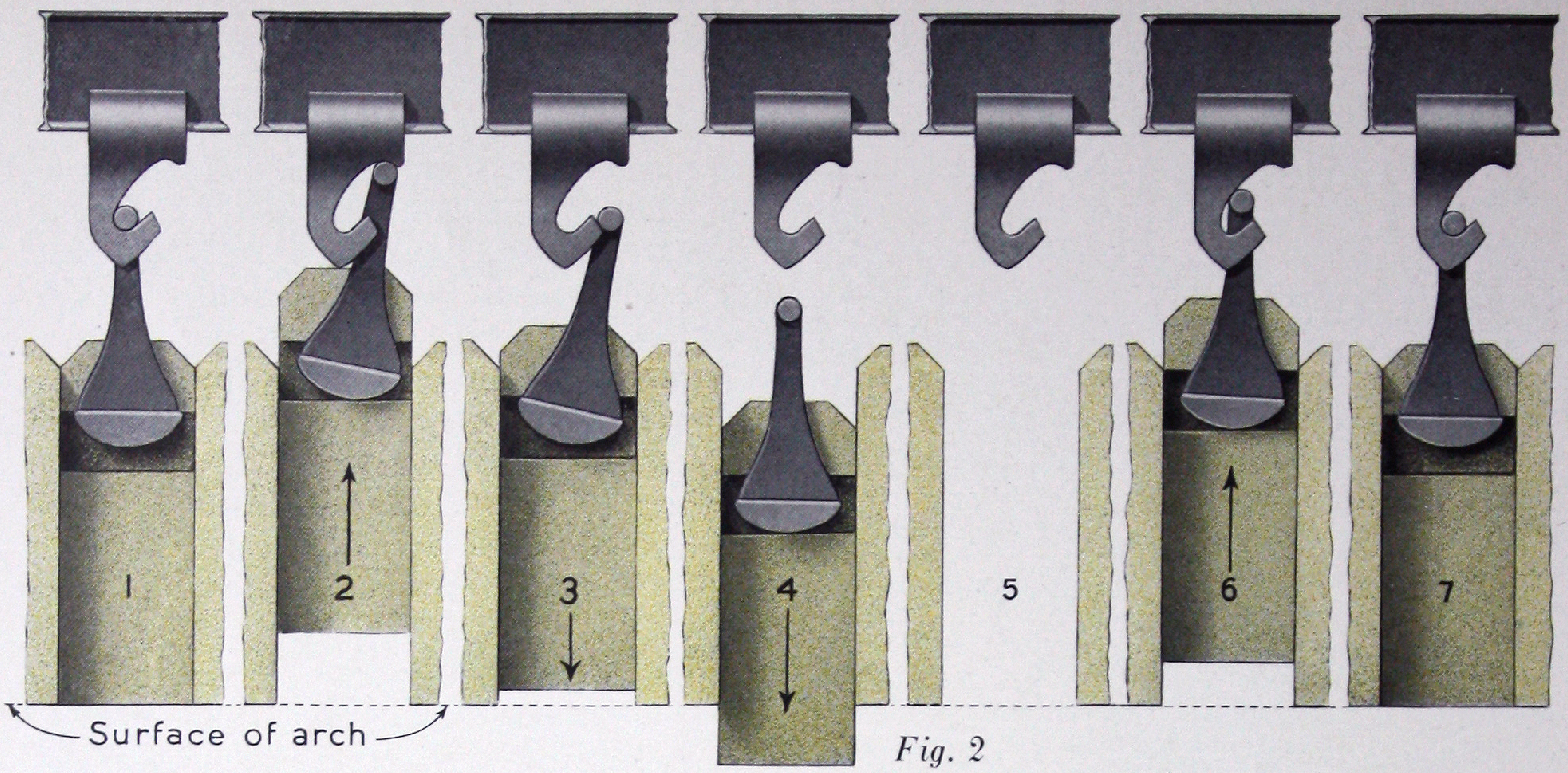


Fig. 2

Typical unit suspension and method of removing and replacing a block from underneath. Clips at the top of the hook fit loosely and slide easily over the lower flanges of the beam. The hook is two-clawed to hold a cylindrical trunnion at the top of the hanger link. An inverted T extension with rocking base on the lower end of the link engages in a corresponding straight grooved slot in the block.

The removal and renewal operation is based upon gravity, acting through rolling contact between bottom of link and groove in block and tending to bring the link back into normal (vertical) position of equilibrium.

The block suspended in normal position (1) is pushed upward (2) until the trunnion, forced against the concave portion of the hook engages the lug on the outer edge of the hanger. A quick drop, before gravity can right the position of the link, carries the trunnion over the outer edge of the claw (3), clear of the hook (4) and the block falls out (5). The new block is then inserted, pushed upward until clear of the outer claw, and held there momentarily until gravity brings the hook upright (6). Dropping then engages the trunnion and hook and leaves the block in its permanent position (7).

A hanger that becomes displaced from its proper position directly above the block, may be adjusted by a rod thrust through the opening.

Where the top surface of the arch is accessible, the blocks are also readily removed from above by grasping the rocking link and pulling the trunnion clear of the hook. This method can be facilitated by sliding the hanger along the hanger beam at the same time.

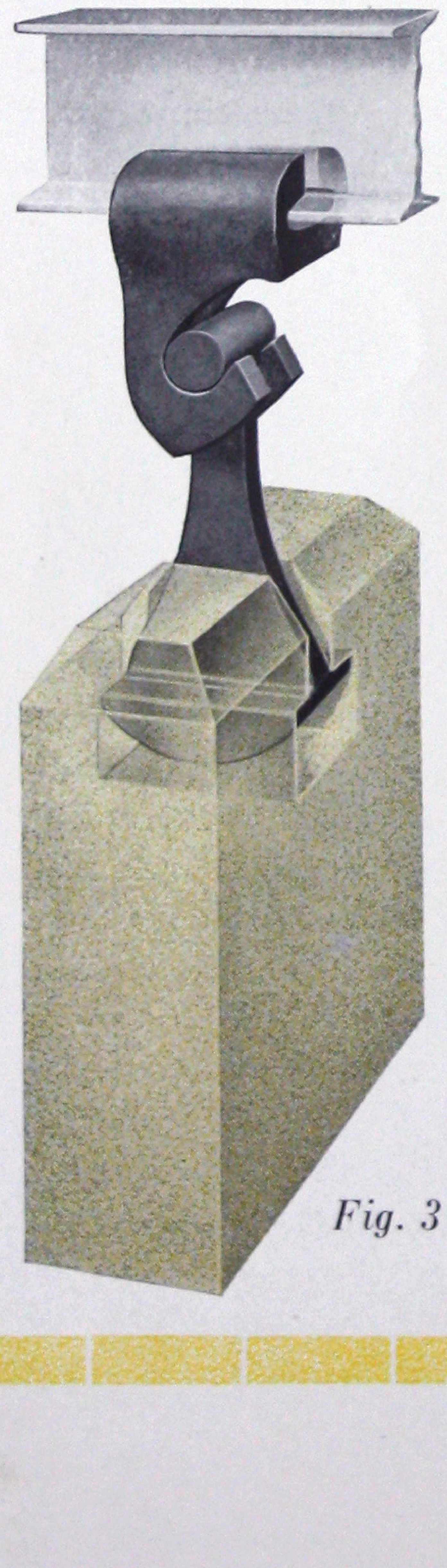


Fig. 3

Rear-end construction

As a protection to the back end of the arch, which is subjected to the greatest heat, and to provide a contour here which will facilitate flow of the gases, a row of special blocks (See Fig. 1) running transversely across the boiler, is fitted against the back row of standard flat blocks.

These rear-end blocks are suspended by special hangers from a transverse bar that is attached to an additional transverse arch beam, parallel with and back of the others.

The end blocks are 4 in. wide and have in their top and side surfaces recesses into which ends of the hanger fit so that when the block is suspended and laid against the last row of standard flat blocks it is securely locked into position.

The tops of these end blocks project slightly above the standard blocks and have flat tops, upon which one or two additional rows of special blocks (See Fig. 1) can be laid to present a flat surface above which the apron wall can be built without hindering easy removal of any of the special end blocks. The apron wall, being usually supported on one or two transverse beams is independent of the arch, and by filling the small intervening space with asbestos as on the other edges of the arch, ample provision is made for expansion and contraction without harmful stresses.

Auxiliary front arches and design variations

THE construction previously described is that furnished for the most frequently met form of water-tube boiler with vertical baffles and manual firing.

Where automatic stokers demand large furnace volume and a main arch set high, an additional short curved arch at the front, as shown in Fig. 1 is desirable to deflect the heat away from the boiler front.

This may be constructed by suspending series of special blocks from corresponding series of special removable cast-iron hangers, the whole being similar to the construction at the back end of the main arch.

Other contours can be secured by using various special shapes of blocks and suspension devices, of which we make a sufficient number of types and sizes to meet all conditions.

The McLeod & Henry method of suspension and shape of blocks for the back end of the main arch and for the auxiliary front arch is decidedly superior to vertical series of wedge-shaped blocks laid one on top of another on a single suspension unit to form a fan-flared row. With this latter construction, expansion and the severe cumulative pressure near the bottom cracks the lower blocks. On account of their wedge shape and the direction in which the pressure is exerted, these blocks, after cracking, drop into the fire box and can be replaced only by removal of the whole row.

Composition of the blocks

THE blocks are made from our well known "Steel Mixture" fire clay which in the form of side-wall lining, plain combustion-chamber arches, boiler-door arches, blow-off pipe protectors and standard fire brick has demonstrated its ability to withstand the highest furnace temperatures, with a minimum of cracking, checking and spalling.

The raw material is a mixture of the best fire clays for the purpose and is specially selected, ground and burned under pyrometer control to give a very tough durable surface with the highest refractory qualities.

Every step in manufacture is under close inspection and frequent heat and crushing tests are made to assure that all finished blocks meet our quality standard.

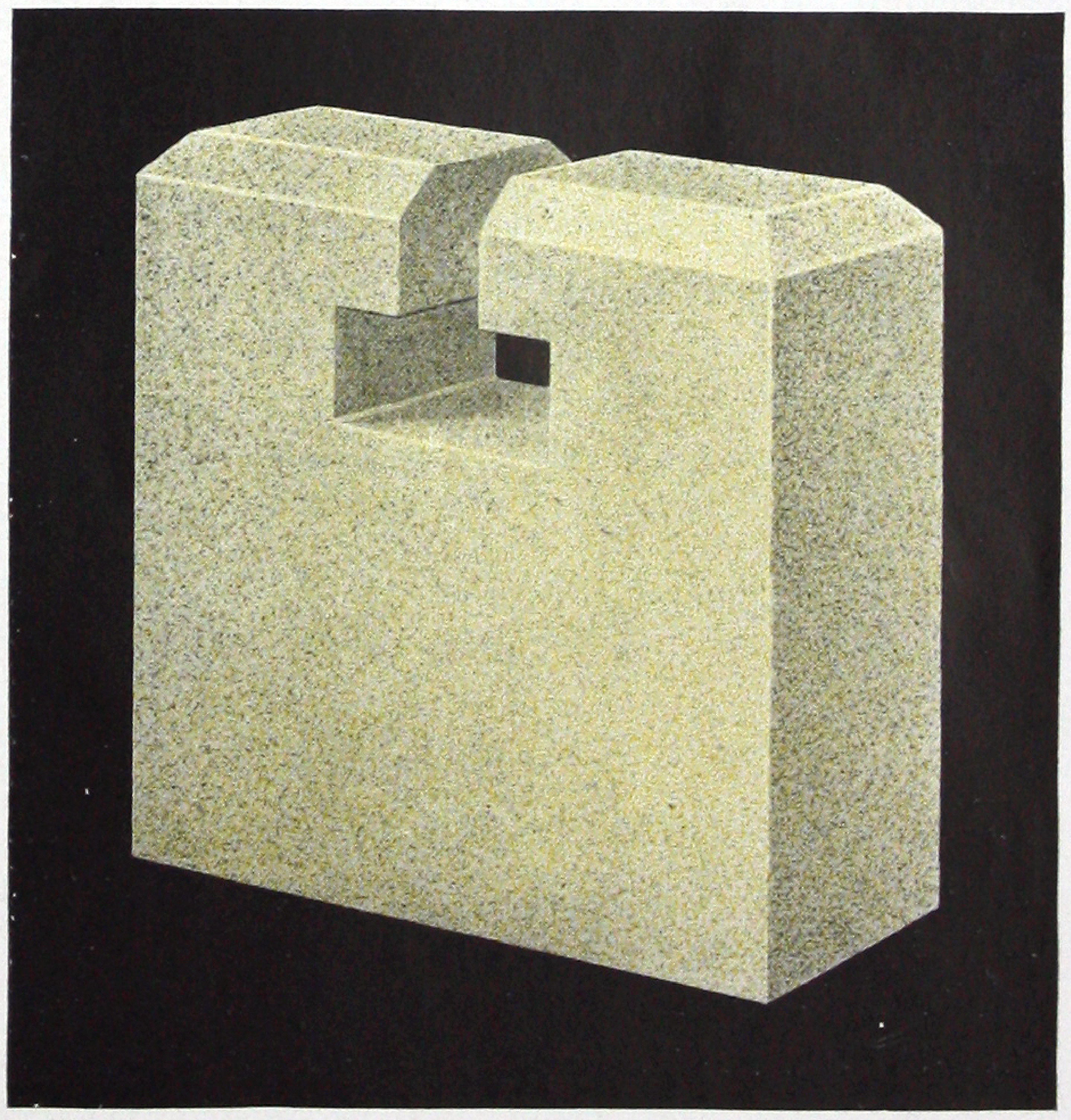


Fig. 4. Standard "Steel Mixture" block for the flat part of the McLeod & Henry Arch. Blocks for arches set with a slope have their bottoms beveled so that with straight downward suspension, the bottom edges meet their neighbors flush on all sides and form a perfectly flat arch surface.

Design flexibility to meet any boiler requirements

McLEOD & HENRY Arches are adaptable to any type, size and make of fire-tube or water-tube boiler, metallurgical furnace or oven fired with solid or powdered coal, coke, oil, bagasse, waste gases, etc.

Slight variations in arrangement, position and size can be made in designing to secure best results with natural or artificial draft, and with horizontal or inclined hand-fired, shaking and dumping grates or with automatic stokers of all types.

Annealing furnaces

ANNEALING and similar furnaces with large top surfaces are usually constructed with a series of parallel top arches, the cumulative horizontal thrust of which is very severe upon the side walls. Even with elaborate systems of stays and tie rods, side walls so burdened, work out of shape and require repairs that necessitate partial renewal of walls and renewal of whole arches or both.

The McLeod & Henry Arch is ideal and quickly repays its cost in this class of furnaces, as it entirely eliminates side thrust on the walls, brings the arch suspension outside where ventilated and protected from warping, gives the flat furnace top so essential to uniform heat distribution, and permits any damaged part of the surface to be almost instantly repaired without delay or disturbance to the rest of the structure.

Engineering service

FURNACE arches should be designed and set with the same care as stokers, baffling, chimneys, etc.

To secure thorough combustion and accelerated ignition, the furnace arch design must be based upon the type of boiler, type of stoker or grate, kind of draft and fuel burned, and power or heat demands, rather than merely on meeting requirements as to available space.

Each arch installation is therefore an engineering problem in itself and is so dealt with by us.

Almost a century of specialization in boiler furnace problems has given us an endless amount of experience and data on which to base our recommendations and assure correct performance.

All engineering service in connection with design is included without extra charge, and in order that the customer may get the most from his investment we consider it a duty as well as a pleasure to extend our co-operation throughout the life of the installation.

Installation

THE installation is so simple that the directions and blue prints which we furnish enable any man of ordinary intelligence to do the erecting without special effort. No skilled masonry work is required and the parts cannot be put together wrong.

It is necessary only to build the walls to proper height to receive the bed plates for the cross or hanger beams, and then put the beams in their proper place. After that the hooks are slid onto the beams, the hangers and blocks added successively and the arch is finished.

Each block is specially inspected for correctness of size, shape and all dimensions and as the hooks and hangers also are entirely interchangeable, there is no need for special care in assembling new parts or returning old ones to their original position.

Immediate shipment of renewal parts

ALL important details of every installation are carefully recorded in our offices and large stocks of all parts are always on hand at our warehouses or works. When renewals do become necessary, the correct new parts are available on short notice, and upon arrival they may be depended upon to fit into place without loss of time.

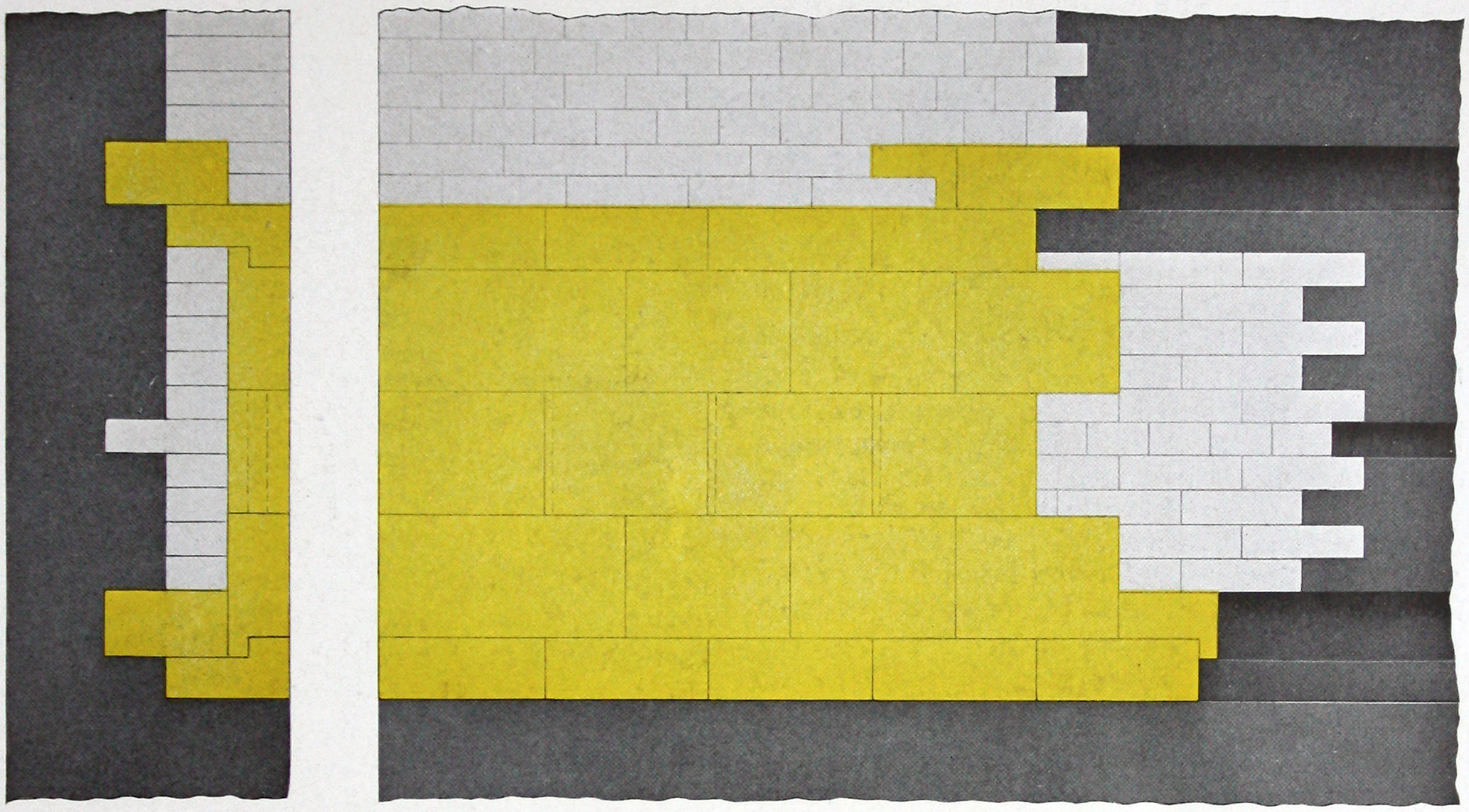
Guarantee

THE McLeod & Henry Arch is guaranteed to meet every claim in these pages and to give thorough satisfaction.

Any parts which can be shown to have been defective at time of sale or which may burn out within one year will be replaced without charge. Any complaint will receive prompt attention.

"Steel Mixture" Veneer Lining

(Patents Pending)



Typical 5-course set of "Steel Mixture" Veneer Lining and backing of ordinary fire brick. Installed to form the fire-box part of a wall, the upper or less exposed portion of which is of standard fire brick, laid for uniform (9-in.) fire-wall thickness from bottom to top. The special tie or anchor blocks are furnished as part of the Veneer Lining set.

The plain fire-brick section of the wall is anchored by laying one row of stretchers above every fourth row of headers and laying a row of headers behind the row of stretchers.

Where the service conditions are not severe, the fire-wall thickness above the Veneer Lining may be reduced to 4½ in. In this instance, the plain fire brick wall is laid with four courses of stretchers to one of headers, the latter forming the anchors.

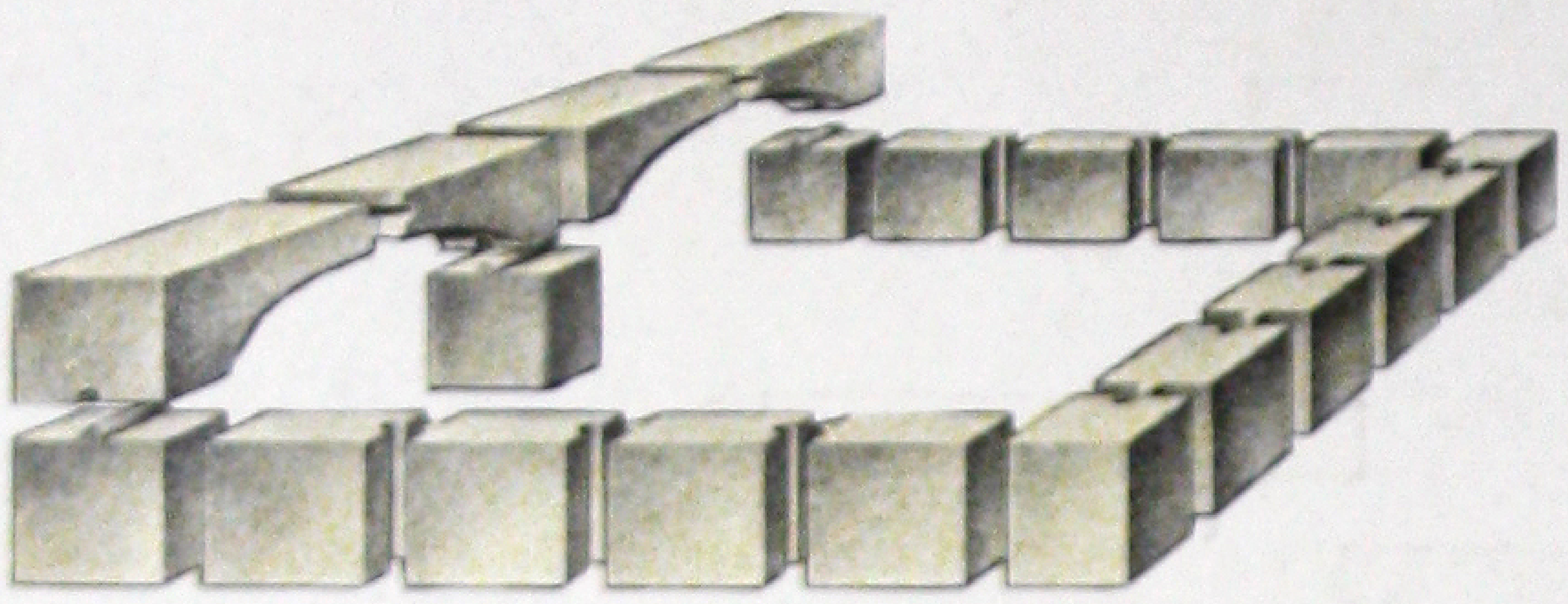
"STEEL Mixture" Veneer Lining extends inward for only part of the thickness of the fire wall, the rest of which can be built from standard fire brick.

This construction is highly desirable in that the part of the fire wall which gets the least punishment is built from cheaper material and becomes permanent while the exposed portion can be renewed with less physical effort and with smaller expense for new material. Inasmuch as the destructive influences, even under the severest duty, seldom impair more than the fire surface, the bulk of the fire wall remains intact and uninjured during the reconstruction period, and maintains the strength of the entire wall structure while the veneer surface is being replaced.

Compared with the usual 9-in. lining, "Steel Mixture" Veneer construction, when repairs are necessary, affords the distinct saving of 4½ inches of the 9-in. lining, or about 50 per cent of material, as the 4½-in. fire brick backing remains in place. The labor cost for the repairs is reduced proportionately and there is likewise a reduction in the time a boiler must be shut down for repairs. *Any small area of the Veneer Lining can be replaced without disturbing the remainder.*

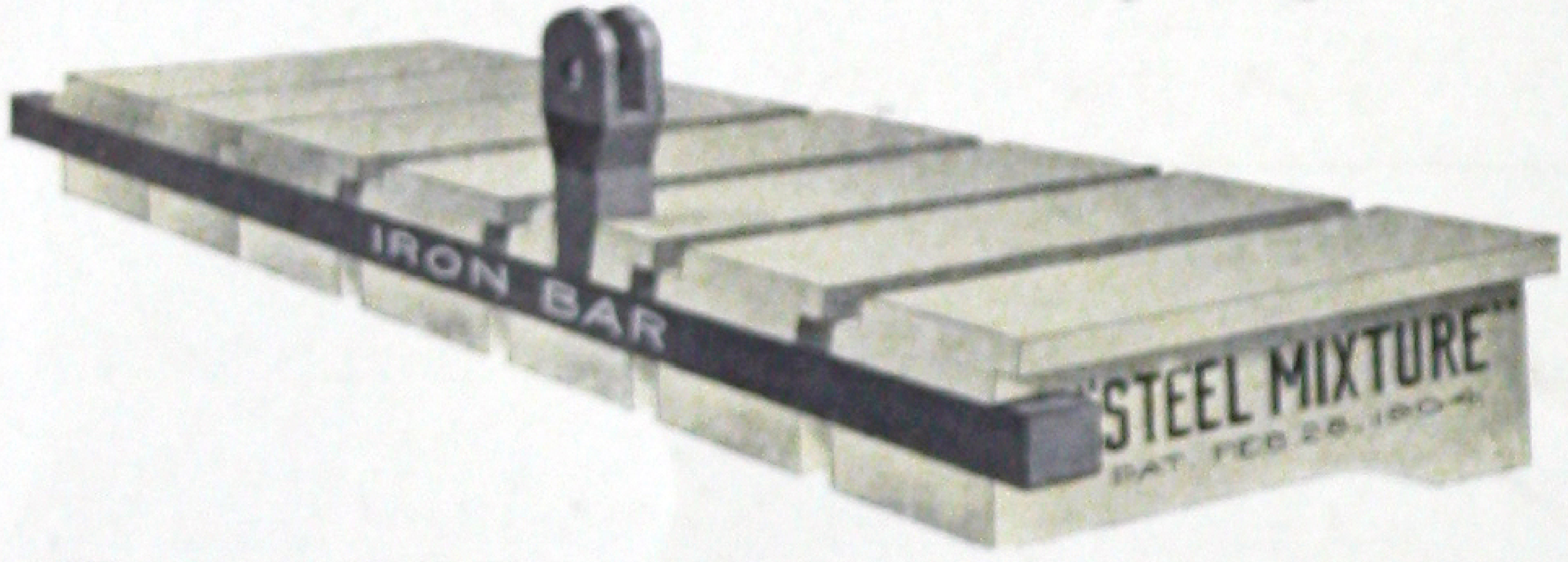
McLEOD & HENRY CO.

Some of the other "STEEL MIXTURE" Products



Boiler-door Arches and Fire-box Blocks

THE strongest furnace wall construction that can be put into a boiler. Save time and labor in erecting and greatly lessen the number of joints, corners and edges in the fire surface. Last twice as long as small brick, shorten furnace shut-downs, and assure rigid, well aligned, gas-tight structure. Sizes for any furnace needs and for any number and size of door openings.



Foote Back-combustion-chamber Arch

(for h.r.t. boilers)

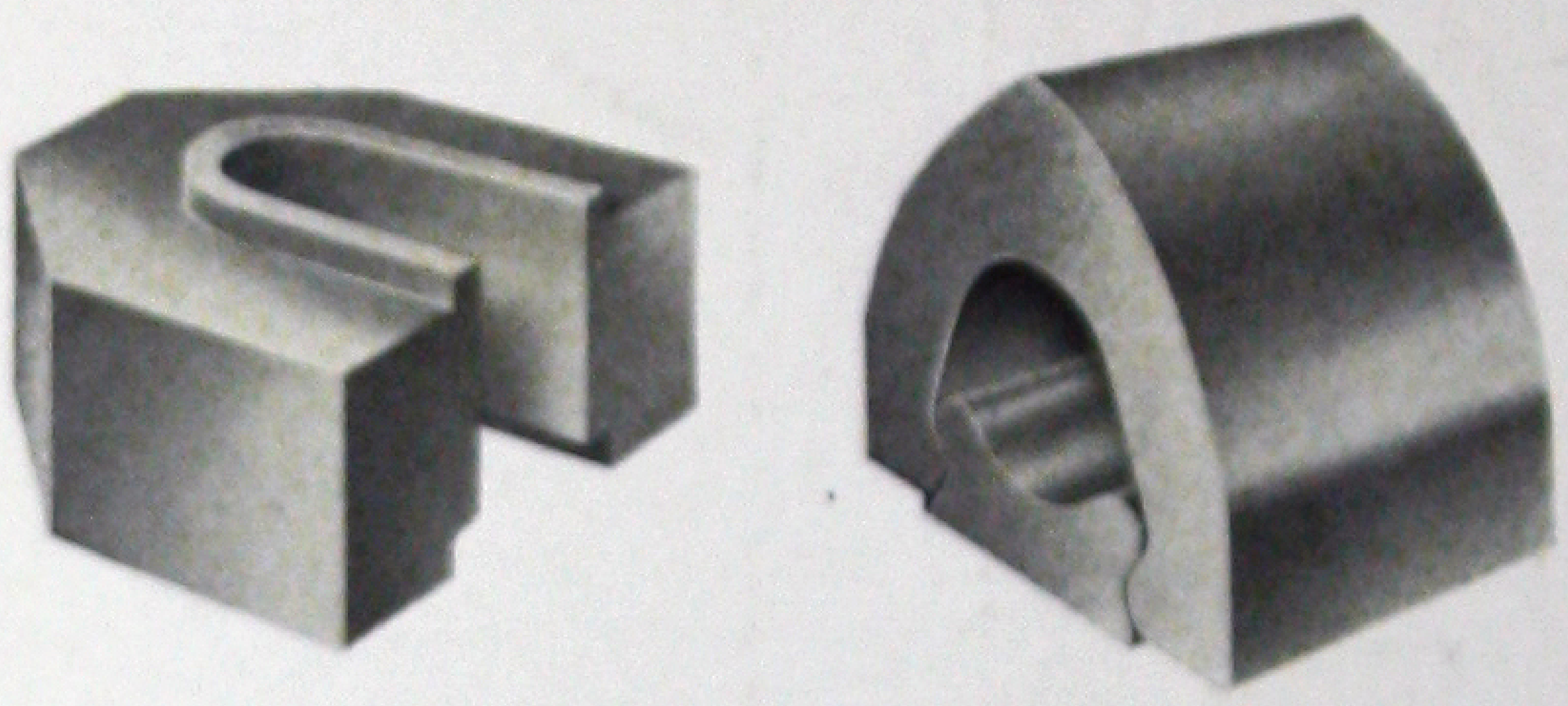
FORMS a complete gas-tight cover for the back combustion chamber and protects the flue sheet to below the water line. Curved underneath to deflect gases into the flues and gives plenty of room for working with the tubes. Erected in an hour and outlasts the boiler.

High-temperature Cement

A CORRECT bonding material and filler for laying, patching and general repair work on all furnace refractories. Air sets and bonds without heat, and will withstand the highest furnace temperatures.

Roof Arch Blocks

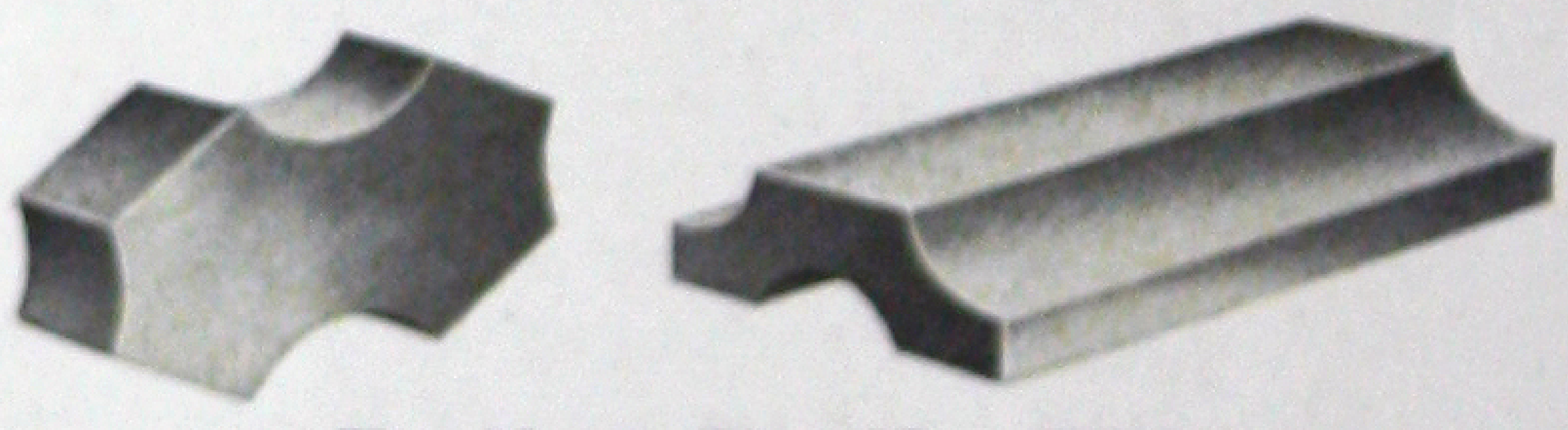
FURNISHED complete with skew-backs, for any radius from 4 to 10 ft. The fit is always tested before shipment.



Blow-off Pipe Protection

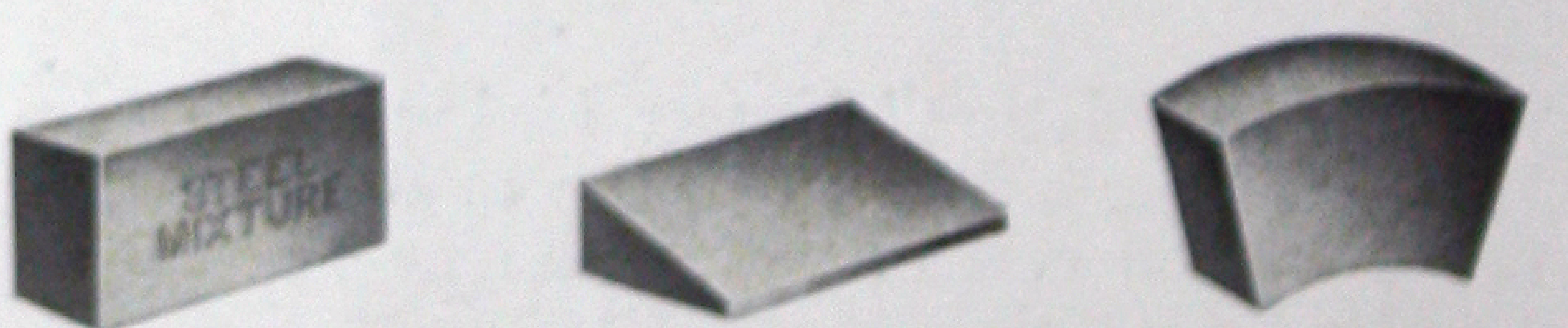
(for h.r.t. boilers)

FITTED around or removed from the pipe in a few minutes. Better than masonry piers and the pipe is accessible for inspection.



Boiler Baffle Tile

SHAPES and sizes for all popular makes of boilers.



Fire Brick and Special Blocks

ALL desirable standard shapes in stock, and specials made for any purpose. Complete or partial refractory equipment for all boilers, metallurgical furnaces, ovens, etc.

Where desired, we submit design and furnish refractory material for the complete boiler or furnace setting

A. EUGENE MICHEL
ADVERTISING ENGINEER
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STEEL MIXTURE

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